

## Role of third molars in orthodontics

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### Abstract

The role of third molars in the oral cavity has been extensively studied over the years. Literature includes numerous diagnostic and treatment alternatives regarding the third molars. However, an issue that has not been discussed at the same level is their involvement in orthodontic therapy. The aim of this study is to present a review of the contemporary literature regarding the most broadly discussed aspects of the multifactorial role of third molars in orthodontics and which are of general dental interest too.

**Key words:** Crowding; Extraction; Eruption; Third molar; Orthodontics; Impaction

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**Core tip:** There are multiple factors associated with the eruption or impaction of third molars. According to the existing literature, orthodontic extraction treatment is not directly associated with the eruption of third molars, but might have a positive effect on their position and angulation. There is currently no reliable research evidence supporting the prophylactic removal of non-pathological impacted third molars for the prevention or relief of mandibular incisor crowding.

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### INTRODUCTION

The development of third molars and their interaction with the rest of the dentition has been of great concern to general dentists and dental specialists for a long time. Third molar is a tooth characterized by variability in the time of its formation and calcification, its crown and root morphology, its course of eruption and final position, presence or absence in the oral cavity<sup>[1,2]</sup>. Third molars start appearing on radiographs as early as the age of 5 years and as late as the age of 16 years, usually erupting in the oral cavity between the ages of 18 and 24<sup>[3]</sup> and they present the highest rate of impaction<sup>[4,5]</sup>.

Although, in the majority of cases, third molars are not directly involved in orthodontic treatment, the fact that, in some cases, they can influence the latter or be influenced it, dictates their direct involvement in treatment planning.

The main issues, concerning the third molars that are related to orthodontic treatment and have been most extensively reported throughout the literature are: the possibility of their eruption or impaction in relation to genetically predetermined factors, the possible repercussion of orthodontic treatment extractions in their position and their influence in orthodontic post-treatment mandibular incisor relapse. These are the topics that are going to be presented and discussed in the herein review.

For the purpose of this study, an extensive online search of PubMed database was conducted. The main focus of the investigation was on original research articles in English. No chronological or other limits were applied.

## FACTORS INFLUENCING THE ERUPTION OR IMPACTION OF THIRD MOLARS

The possibility of eruption of third molars is of important consideration in treatment planning and in the long-term maintenance of the dentition and, therefore, of particular interest to dentists and orthodontists<sup>[6]</sup>.

The presence or absence of third molars from the oral cavity has been related to genetically predetermined skeletal and/or dental factors. As early as 1936, Bowdler *et al.*<sup>[7]</sup> suggested that the individual growth pattern is an important factor for the eruption of the third molar. Broadbent<sup>[8]</sup> believed that the inability of the mandible to achieve its full growth potential may be contributing to the impaction of third molar, whereas, according to Begg<sup>[9]</sup>, the impaction of third molars is attributed to insufficient forward movement of the teeth of modern man due to the lack of interproximal attrition that was observed in ancient skulls.

Björk *et al.*<sup>[10]</sup>, in an early study, reported that in 90% of third molar impaction cases the retromolar area space was limited. A few years later, in a longitudinal cephalometric study<sup>[11]</sup> of 243 cases with the use of implants, he identified two skeletal and two dental factors that were linked with the impaction of mandibular third molars. These factors were: a vertical direction of condylar growth, a reduced mandibular length, a backward-directed eruption of the mandibular dentition and a retarded maturation of the third molars. However, in the same study, it is also stated that, depending on the case, these three factors "may either amplify or neutralize each other".

Ricketts *et al.*<sup>[12]</sup>, used longitudinal records in an attempt to predict the amount of mandibular growth and to estimate the amount of space for forward and upward development of the molars. He concluded in that, in order the third molar to have a 50% chance of erupting, 50% of the crown must lie ahead of the external ridge. In a previous study<sup>[13]</sup>, he had also

claimed that the direction of tooth eruption plays a critical role in the impaction of third molars.

Kaplan<sup>[14]</sup> also agreed that cases with impacted third molars exhibit a larger angle of mandibular growth compared with cases with erupted third molars. The distance from Xi cephalometric point to the distal surface of the second permanent molar, was used by Schulhof<sup>[15]</sup>, in an attempt for a computerized prediction of third molar impaction. When this length decreased below 25 mm impaction became more likely and, conversely, less likely as the length increased towards 30 mm. However, this method of prediction presupposes impaction being solely related to available space.

Richardson<sup>[16]</sup>, in a longitudinal study of a group of 95 subjects observed that skeletal Class II cases, with a shorter in length, narrower in width and more acute angled mandible, were more prone in third molar impaction. There was also a reduced amount of mandibular growth in cases with impacted third molars, which also had a tendency, although non-significant, to be relatively larger in size. The developmental initial mesial angulation of third molars in relation to the mandibular plane was also increased in subjects with impacted third molars. Ades *et al.*<sup>[17]</sup>, after studying the data from cephalometric radiographs and study models from 97 patients, found no significant differences in mandibular growth between those who had impacted or fully erupted mandibular third molars.

Capelli<sup>[18]</sup>, using a sample of 60 patients who had received orthodontic treatment, including the extraction of four premolars, stated that, according to his results, the impaction of third molars is associated with a vertical component of mandibular growth, high mesial inclination of the lower third molar crown in the ascending ramus and reduced mandibular length. Hattab<sup>[19]</sup>, in a radiographic follow-up study of 36 students with an average age of 19.7 years, discovered that a significant proportion of mesially impacted mandibular third molars changed their angulation and became fully erupted by the time the individuals reached 24 years of age. Therefore, he concluded that the positional changes and the eruption of impacted mandibular third molars are two unpredictable phenomena.

Erdem *et al.*<sup>[20]</sup> examined the data from lateral cephalograms, orthopantomograms, periapical radiographs and study models of 27 patients and came to the conclusion that impaction of lower third molar is an unpredictable event. However, they also stated as a conclusion that the chances of eruption for mandibular third molars are more increased in patients with a more vertical growth pattern in general and a vertical direction of condylar growth, with anterior rotation of the mandible. In addition, a greater mesial inclination of the impacted lower molars was also mentioned as a possibly contributing

factor in their occurrence of impaction.

Artun *et al.*<sup>[21]</sup>, in an attempt to identify risk factors for maxillary third molar impaction, examined the radiographs of 132 adolescent patients. According to the results of their analyses, the most predictive parameters of impaction were a mesial angulation and a distal angulation of more than 30 degrees of the maxillary third molars relative to the occlusal plane, a reduced retromolar space and a small mandibular plane/Sella-Nasion plane (MP/SN) angle. In a study published in the same year, Artun *et al.*<sup>[22]</sup> retrospectively investigated the lateral cephalograms, panoramic and/or periapical radiographs and study models of 389 patients who had received orthodontic treatment with or without extractions. They concluded that mandibular third molars angulated more than 40 degrees mesially relative to the occlusal plane at the end of treatment may also be at increased risk of impaction.

Behbehani *et al.*<sup>[23]</sup>, in a retrospective radiographic study of 134 patients, concluded that increased mesial angulation of the third-molar buds and signs of pronounced forward mandibular growth rotation increase the risk of impaction. Eruption space and mandibular growth rotation were also indicated as the most predictive parameters of impaction. Breik *et al.*<sup>[24]</sup>, in the contrary, reported that subjects with horizontal facial growth pattern demonstrated two times lower incidence of third-molar impaction than subjects with vertical growth pattern. Legović *et al.*<sup>[25]</sup>, on the other hand, in the same year, had not found any significant differences between the position of lower third molars and type of facial growth.

Finally, Hassan<sup>[26]</sup>, in a retrospective cephalometric study of 121 Saudi patients, concluded that third molar impaction is more likely to occur when the retromolar space is inadequate. The latter was attributed to different skeletal and dental features, including an increased width of the mandibular ramus and a backward rotation of the posterior teeth.

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## EFFECT OF PERMANENT TEETH EXTRACTIONS ON THIRD MOLARS

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Orthodontic treatment, especially during the period of active growth, may significantly influence the development of the dentition. Third molars too, according to the existing literature, are affected by orthodontic therapy in various ways. One of them is the orthodontic extraction treatment, the effect of which on third molars has been broadly investigated. The teeth that are usually removed for orthodontic reasons are the premolars, the first and the second permanent molars, either bilaterally or unilaterally, depending on the individual treatment requirements.

When it comes to extraction therapy, Kaplan<sup>[14]</sup> was one of the first authors to suggest that premolar

extractions increase the probability of third molar eruption. According to the same author, when eruption does not occur in extraction cases, an insignificant resorption of the anterior border of the ramus is probably responsible, which is associated with vertical growth type.

Williams *et al.*<sup>[27]</sup>, in a study examining the effect of different extraction sites on orthodontic incisor retraction in 260 cases of patients of the same age at (mean age 13 years), treated with the Begg technique, also investigated on the influence of extractions on third molar eruption. According to their results, the change in the rate of third molar eruption following premolar extractions was indifferent, in contrast with first molar extractions or a combination of first premolar and first molar extractions, which had a significantly positive impact.

Rindler<sup>[28]</sup>, in his investigation, examined the data from the casts and lateral oblique radiographs of 78 patients between 10 and 15 years of age, with a Class II initial malocclusion and crowding in the lower arch. The patients were treated with different techniques and had both their second mandibular molars extracted at the same time with the initiation of root development of the third molars. In 21 cases no additional orthodontic treatment was involved and, in the rest of the cases, lower first molars were moved distally with the use of activators (9 cases) and fixed appliances (48 cases). As they reported in the summary of their study, the third molars successfully replaced the second molars in most cases (77%).

Haavikko *et al.*<sup>[29]</sup>, after the analysis of a set of 110 longitudinal orthopantomograms of patients with a mean age of 13.5 years at the start of treatment, 50 of which had had two lower premolar extractions, concluded that the possibility of lower third molar eruption increased only occasionally and that extraction treatment seemed to merely accelerate and not promote eruption. Gaumond<sup>[30]</sup> used a relatively smaller study group of 11 patients, with different types of malocclusion, which were treated with germectomy of their second molar buds, as soon as the germ of a respective third molar was visible on a radiograph. As he reported, 19 of the 22 third molars that were followed-up achieved "satisfactory of very satisfactory" positions with acceptable final angulations. Based on the outcomes of this study, the author's belief was that every case with mild or moderate mandibular crowding should be treated in this way, rather than with four premolar extractions.

Cavanaugh<sup>[31]</sup>, in a clinical and radiographic evaluation of third molars after second molar extractions in 25 patients, all of which, except for 2, had had some kind of orthodontic treatment, suggested that third molars usually successfully erupt into the space provided by the removed second molars. Richardson<sup>[32]</sup> conducted a retrospective investigation

of the records (casts and sixty-degree cephalometric radiographs) of a group of 48 subjects that had had unilateral or bilateral mandibular first premolars extractions and of a control group with no mandibular extractions. She concluded that there was a significantly increased space for third molar eruption in the group of the extraction cases. She could still, though, not explain the fact that a number of third molars had become impacted in extraction cases.

Gooris *et al.*<sup>[33]</sup> conducted a study using 95 sets of panoramic radiographs of patients, within an age range of 9 to 19 years, who had received orthodontic treatment involving second molar extractions and first molar distalization. Their measurements indicated that almost all erupted third molars presented with a mesial inclination. Stagers *et al.*<sup>[34]</sup>, in a retrospective study of panoramic radiographs from 78 orthodontically treated subjects, 33 of which had been treated with four premolar extractions, concluded that there was no relative considerable impact of the extractions on third molar angulation. All the patients used in the study had Class I skeletal and dental relationships, they were treated with straight-wire appliances and the age range was roughly 11-26 years for the extraction group and 11-17 for the non-extraction group.

Richardson *et al.*<sup>[35]</sup> cooperated in a retrospective study regarding the evolution of third molars after second permanent molar extractions. In total, 63 sets of records (lateral cephalographs and study models) were selected, from patients that had bilateral or unilateral (8/63) second molar extractions. Twenty-three/sixty-three patients had acceptable initial occlusion and had not received additional orthodontic treatment. Based on the results of this study, the authors suggested that there was a tendency of mandibular third molars to autocorrect their bucco-lingual inclination subsequent to second molar extraction and that the earlier the developmental stage of a third molar is at the time of extraction the higher are the chances for their eruption.

Moffitt<sup>[36]</sup> evaluated a subgroup of 56 patients, 28 of which had unilateral maxillary second permanent molar extractions, clinically, radiographically and *via* their study models, regarding the effect of extractions in the third molar eruption and function. The results showed that after second molar extractions maxillary third molars erupted in most cases in acceptable positions and that their eruption was also accelerated in variable degrees. Orton-Gibbs *et al.*<sup>[37]</sup> aimed to assess with their study the final position of third molars after the extraction of second molars, in a retrospective radiographic analysis of the records of 63 patients, with a mean age of 13 years and 3 mo and different initial types of malocclusion. According to the results of this study, both maxillary and mandibular third molars in most cases erupted in "good or acceptable"

positions, based on "Richardson's score system"<sup>[35]</sup>. They also noted that the angulation of mandibular third molars improves further after the end of active treatment.

Elsy *et al.*<sup>[3]</sup> conducted their own study with the objective to evaluate the influence of the extraction of mandibular premolars and subsequent orthodontic closure of the extraction spaces on the third molar development. A set of 30 consecutive patients' records with bilaterally impacted lower third molars and a history of lower premolar extraction treatment. A control group with lower premolar and third molar extractions was also used. Measurements were made on panoramic radiographs. Retrospective analysis of the collected data indicated a positive influence of lower premolar extraction on the position and inclination of impacted third molars.

Kim *et al.*<sup>[38]</sup>, in a retrospective study of the diagnostic records of 157 patients, 105 of which had four premolar extraction-treatment during their active growing stage of development, suggested that there was a clinically significant reduction in the impaction rate of both maxillary and mandibular third molars in these patients in comparison to the non-extraction group.

Janson *et al.*<sup>[39]</sup>, comparing the records of two groups of 55 patients in total, in their late adolescence, with and without maxillary premolar extractions, concluded that the number of erupted maxillary third molars was greater in the extraction group. He also claimed that the mesio-distal angulations of the un-erupted molars appeared relatively decreased and, therefore, more favorable to eruption.

De-la-Rosa-Gay *et al.*<sup>[40]</sup> conducted a retrospective study based on data from panoramic radiographs, with the aim not only to assess third molar eruption after second molar extraction orthodontic treatment, but to identify the risk factors of unsuccessful eruptions too. Their sample included 48 patients, treated with fixed appliances (Ricketts or straight-wire techniques), with a median age of 14.8 years. The analysis of their results indicated that maxillary and most mandibular third molars successfully erupted and eventually obtained upright positions. Both late developmental stage of third molars and increased mesial inclination or lack of proximal contact in the beginning of treatment were identified as risk factors for an unsuccessful eruption.

Salehi *et al.*<sup>[41]</sup>, assessing the effect of first premolar extractions on third molar eruption, evaluated the clinical records of three groups of subjects: a group with first premolar extractions, a group with no extractions that had received orthodontic treatment and a control group with neither extractions nor orthodontic treatment. According to their results, there was a significant difference in the third molar eruption rates in the extraction (42%), non-extraction (12%) and control (20%) groups. These

findings indicate that first premolar extractions may increase the possibility of third molar eruption.

Jain *et al.*<sup>[42]</sup>, in a retrospective study that they conducted with the use of panoramic radiographs also investigated on the effect of first premolar extraction treatment. Their study sample consisted of 50 dental Class I patients, between the ages of 11 and 19, half of which had received four first premolar extractions. In addition, no more than the 2/3 of the third molars had been formed in the initial radiographs and extraction spaces had been eliminated in the end of orthodontic treatment. The analysis of the collected data indicated a positive influence of first premolar extractions on the angulation of third molars.

Bayram *et al.*<sup>[43]</sup> investigated the influence of orthodontic treatment involving four first molar extractions on the third molars. It was a retrospective study on panoramic radiographs from 41 patients, with a mean age of 16.6 years of age, 21 of which were treated with extraction of all four first permanent molars. No extraoral forces were used for the treatment of the above patients. According to their conclusions, first molar extractions may considerably increase the eruption space of third molars, whereas they normally have a more favorable effect on the angulation of the maxillary than of mandibular third molars. The main conclusion of this study was that the extraction of first permanent molars considerably reduces the frequency of third molar impactions.

Livas *et al.*<sup>[44]</sup> used for their study lateral cephalometric radiographs from a group of 91 subjects, with a mean age of 13.2 years of age, treated with the orthodontic Begg technique and an initial Class II Division 1 malocclusion. The subjects were divided in a group with first molar extractions and a control group with no extractions, which consisted of Class I and Class II cases. The findings of this study suggest that the position of third molars was significantly improved during orthodontic treatment involving the extraction of first molars.

Gohilot *et al.*<sup>[45]</sup>, almost two years ago, published an investigation regarding the impact of first premolar orthodontic extraction treatment on third molars. The study sample included 60 Indian patients, between 14-19 years of age, 30 of which had all first premolars extracted and the rest serving as a control non-extraction group. The root development of third molar roots did not exceed the 2/3 of its full length at the initial radiographs, all patients had been initially diagnosed with a skeletal and dental Class I malocclusion, which meant that they all had been high-anchorage cases during treatment and there were no extraction spaces in the end of treatment. Based on their results, they concluded that premolar extractions had a positive effect on maxillary third molar angulations, whereas they did not notice any difference in mandibular third molars' positions. They also suggest that borderline extraction cases with favorable third molar angulations could benefit by

premolar extractions.

Türköz *et al.*<sup>[46]</sup>, comparing two groups of 22 non-growing patients, with and without first premolar extractions in a retrospective study, also revealed a positive influence of premolar extraction therapy in the size of retromolar space and a significantly lower impaction rate of third molars in the corresponding extraction group. Mihai *et al.*<sup>[47]</sup> evaluated the panoramic radiographs of 20 initially Class I patients, who had received orthodontic treatment, with and without premolar extractions and the crowns of their third molars had already been formed in the beginning of treatment. The results of this study indicated the third molars with the most favorable positions, were the ones in the mandibles of the extraction group.

Al Kuwari *et al.*<sup>[48]</sup> conducted a cross-sectional radiographic study, using 40 sets of patient records from a university clinic. Half of these patients were orthodontically treated with first premolar extractions. According to their results, orthodontic treatment premolars extraction treatment seems to have improved the angulation of impacted third molars in most cases. Finally, Halicioglu *et al.*<sup>[49]</sup> recently published a large retrospective study of the panoramic radiographs of 294 patients, aged from 13 to 20 years, with at least one permanent first molar extraction. Among other conclusions, they report that the development of the third molars was significantly accelerated on the extraction sites of these patients.

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## THIRD MOLARS AND MANDIBULAR INCISOR CROWDING

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The effect of third molar position and eruption stage on the rest of the dentition has also been the subject of many investigations and is also of great concern to the orthodontists. Especially the role of third molars in the development of a secondary mandibular incisor crowding has been an object of debate for many years.

As early as 1917 Dewey<sup>[50]</sup>, examining the role of third molars in malocclusion, suggested that, in some cases, the mandibular third molars need to create space in the dental arch in order to erupt, causing crowding of the anterior teeth. Since then, numerous investigations have been conducted in an attempt to objectively identify a possible correlation between third molars and mandibular incisor crowding. Bergström *et al.*<sup>[51]</sup> studied 60 subjects with unilateral molar agenesis and noted that there was greater crowding in the quadrants in where third molars were still present, than in those in which third molars they were absent. Vego<sup>[52]</sup> also found a greater percentage of dental crowding in subjects with erupting third molars in comparison to subjects with congenitally missing third molars.

Sheneman<sup>[53]</sup>, in an investigation of 49 patients for a mean period of 66 mo, concluded that patients with congenitally missing third molars showed comparatively greater dental stability.

Woodside<sup>[54]</sup>, on the other hand, suggested that in cases where mandibular third molars were not present, a more distal settling of the lower dentition occurred in response to growth and soft tissue pressure, implying a passive role for the third molar, which was acting as an obstacle to the settling of the dentition, rather than actively applying pressure to anteriorly positioned teeth.

Lindqvist *et al.*<sup>[55]</sup>, in their study, examined a group of 52 patients with bilateral third molar impactions. It was a "split mouth" design study, with extraction of the impacted molars on one side and use of the contralateral quadrant as a control side. Their data indicated the existence of less crowding on the extraction side, in 70% of the patients. Forsberg<sup>[56]</sup> conducted a study with the objective to identify the relationship between the eruption status of third molars and the relative space in the dental arches. Two groups of 75, in total, adult, non-orthodontic patients were used; one group with patients that had all third molars erupted and another group with all third molars missing due to extraction. The degree of crowding was found to be higher in the first group, although only with a small difference.

Southard *et al.*<sup>[57]</sup> attempted to detect the presence of a mesial force exerted by the unerupted third molars on the rest of the dentition, by measuring and comparing proximal contact tightness before and after bilateral third molar extractions in 20 patients. The authors concluded that the removal of third molars for the relief of "interdental pressure" and, therefore, for the prevention of mandibular incisor crowding could not be supported by the results of their study. Pirttiniemi *et al.*<sup>[58]</sup> examined the effect of impacted third molar extraction on the dental arches in patients with a mean age of 23.2 years. As it is stated in their conclusions, the results of this investigation could not justify the prophylactic removal of third molars, due to the absence of relative evidence regarding their association with undesirable changes in the dental arches.

van der Schoot *et al.*<sup>[59]</sup> conducted an investigation with the aim to determine the relationship between dental crowding and the presence of third molars. Their sample included 99 orthodontically treated patients. According to their results the presence of third molars did not have a clinically significant relationship with the development of post-treatment crowding. Basdra *et al.*<sup>[60]</sup>, in an evaluation of 19 patients, who had been recalled in a university dental clinic and had had orthodontic Class II treatment with bilateral or unilateral upper second molar extractions, reported that all third molars had erupted in very good positions.

Sidlauskas *et al.*<sup>[61]</sup> investigated in their study the

effect of lower third molars in lower incisor crowding, by studying the records (study models and panoramic radiographs) of 91 patients, who had not received orthodontic treatment before the collection of the records. The study group included patients with present, removed or genetically missing third molars. They concluded that the third molars in their study group were not responsible for any considerable difference in the development of lower anterior dental arch crowding. Hasegawa *et al.*<sup>[62]</sup> studied a group of Mongolian subjects, with a mean age of 21 years, in order to evaluate the influence of third molars on lower anterior crowding. The analysis of their data did not reveal any significant relationship between the presence and angulation of mandibular third molars and lower incisor crowding.

Karasawa *et al.*<sup>[63]</sup>, in a cross sectional-study, aimed to reveal a correlation between the presence of third molars and mandibular incisor crowding in a large group of 300 subjects, with a mean age of 20.4 years. Their final results revealed no correlation between maxillary or mandibular third molars and the incisor crowding. Nevertheless, in patients that had had orthodontic treatment there was a small correlation, although this result did not reach statistical significance.

Costa *et al.*<sup>[64]</sup> recently conducted a systematic review in order to investigate whether the prophylactic removal of third molars is justified as a treatment option. After filtering of the initial studies with the use of specific eligibility criteria, only 4 papers of medium (3) and low (1) quality and inadequate sample sizes eventually contributed in the analysis. As stated by the reviewers, the currently available data is inadequate for the formation of safe conclusions, which could be used in clinical treatment decisions. However, their results point towards the opinion that prophylactic third molar extraction is unjustifiable.

## DISCUSSION

With regards to the possibility of third molar eruption, it seems that most investigators agree on the fact that there is a correlation between third molar impaction and certain skeletal characteristics<sup>[7-9,10,12-16,18,20-24,26]</sup>, although not everyone shares the same opinion<sup>[17,19,25]</sup>. The common associated factor is the shortage of the available eruption space, due to distally directed eruption of the dentition and/or lack of adequate resorption of the anterior border of the mandibular ramus or compensatory periosteal bone apposition at the posterior outline of the maxillary tuberosity. Another factor that is linked with third molar impaction is the existence of a vertical facial growth pattern, with a vertical direction of condylar growth. Finally, increased third molar angulation is also considered to be significantly linked to third molar impactions.

Concerning the impact of extraction treatment,

the majority of investigators have reported a positive influence of the removal of teeth for orthodontic reasons on third molar position, angulation and/or eruption<sup>[3,14,27,28,30,31,33,35-48,60]</sup>. The improvement of the position and reduction of the inclination of third molars, although not directly associated with their eruption, seems to be considered as a very positive effect. Many authors also believe that orthodontic borderline extraction cases with favorable initial third molar angulations could benefit from extraction therapy<sup>[41,44,47]</sup>. In addition, even in the event of a possible future extraction of impacted third molars, a more upright position could facilitate the surgical procedure and minimize possible complications and post-operative complications<sup>[3,8,41]</sup>.

However, it is important to note that there is a variety of confounding factors that could have affected the results of the above studies and were not co-evaluated in most cases, including the age of the patients, their ethnical background, the developmental stage of third molars at the time of the extractions, the initial types of malocclusion and the type of mechanics that were used for the needs of the orthodontic treatment.

Further, concerning the role of third molars in mandibular incisor crowding, it is very interesting to note the differences between the authors' beliefs and results before and after the 1990's. In the chronologically older studies<sup>[50-56]</sup> third molars seem to be more significantly associated with the occurrence of crowding in the lower arch. In contrast, more recent studies<sup>[57-59,61-64]</sup> tend to exculpate third molars and characterize their prophylactic extraction as unjustifiable. Nonetheless, both recently conducted systematic reviews on this matter, although clearly not in favor of prophylactic extractions, reported the insufficiency of high quality studies, required for the formation of secure conclusions.

The fact still is that, currently, there is no sound research evidence supporting the prophylactic removal of non-pathological impacted third molars. However, in cases where extraction is indicated, it is preferable third molars to be removed before adulthood in order to decrease the risk of complications<sup>[65]</sup>.

Finally, other important clinical issues, including the impact of orthodontic first molar distalization on third molar position, the effect of third molar eruption stage on the efficiency of first molar distalization, the orthodontic force application on autotransplanted third molars, the orthodontic extraction of third molars in unfavorable positions or in close proximity to the inferior alveolar nerve and the decision of the extraction of third molars before orthognathic surgery, are also still under investigation and are, hopefully, going to be included in other reviews.

## CONCLUSION

Despite the fact that the role of third molars has been

a subject of research, clinical interest, discussion and dispute for so many years, there is still a lack of scientific evidence from high quality clinical studies on that matter. Several weaknesses have been pointed out, including the heterogeneity of data and the small size of the examined samples. However, the information collected from the studies presented in this review contributes to our knowledge and allows us to create a fuller picture regarding the issues that have been examined.

## REFERENCES

- 1 **Saysel MY**, Meral GD, Kocadereli I, Taşar F. The effects of first premolar extractions on third molar angulations. *Angle Orthod* 2005; **75**: 719-722 [PMID: 16287223]
- 2 **Celikoglu M**, Kamak H, Oktay H. Investigation of transmigrated and impacted maxillary and mandibular canine teeth in an orthodontic patient population. *J Oral Maxillofac Surg* 2010; **68**: 1001-1006 [PMID: 20188449 DOI: 10.1016/j.joms.2009.09.006]
- 3 **Elsej MJ**, Rock WP. Influence of orthodontic treatment on development of third molars. *Br J Oral Maxillofac Surg* 2000; **38**: 350-353 [PMID: 10922167]
- 4 **Dachi SF**, Howell FV. A survey of 3, 874 routine full-month radiographs. II. A study of impacted teeth. *Oral Surg Oral Med Oral Pathol* 1961; **14**: 1165-1169 [PMID: 13883048]
- 5 **Bishara SE**, Andreasen G. Third molars: a review. *Am J Orthod* 1983; **83**: 131-137 [PMID: 6572040]
- 6 **Kandasamy S**, Rinchuse DJ, Rinchuse DJ. The wisdom behind third molar extractions. *Aust Dent J* 2009; **54**: 284-292 [PMID: 20415925]
- 7 **Bowdler H**, Morant GM. A preliminary study of the eruption of the mandibular third molar tooth in man based on measurements obtained from radiographs, with special reference to the problem of predicting cases of ultimate impaction of the tooth. *Biometrika* 1936; **28**: 378-427 [DOI: 10.2307/2333956]
- 8 **Broadbent BH**. The influence of the third molars on the alignment of the teeth. *Am J Orthod Oral Surg* 1943; **29**: 312-330 [DOI: 10.1016/S0096-6347(43)90384-9]
- 9 **Begg PR**. Stone Age man's dentition. *Am J Orthod Dentofac Orthop* 1954; **40**: 298-312. Available from: URL: [http://www.journals.elsevierhealth.com/periodicals/ajorth/article/0002-9416\(54\)90103-7/](http://www.journals.elsevierhealth.com/periodicals/ajorth/article/0002-9416(54)90103-7/)
- 10 **Björk A**, Jensen E, Palling M. Mandibular growth and third molar impaction. *Acta Odontol Scand* 1956; **14**: 231-272
- 11 **Björk A**. Variations in the growth pattern of the human mandible: longitudinal radiographic study by the implant method. *J Dent Res* 1963; **42** (1)Pt 2: 400-411 [PMID: 13971295]
- 12 **Ricketts RM**, Turley P, Chaconas S, Schulhof RJ. Third molar enucleation: diagnosis and technique. *J Calif Dent Assoc* 1976; **4**: 52-57 [PMID: 1074850]
- 13 **Ricketts RM**. A principle of arcial growth of the mandible. *Angle Orthod* 1972; **42**: 368-386 [PMID: 4507153]
- 14 **Kaplan RG**. Some factors related to mandibular third molar impaction. *Angle Orthod* 1975; **45**: 153-158 [PMID: 1056712]
- 15 **Schulhof RJ**. Third molars and orthodontic diagnosis. *J Clin Orthod* 1976; **10**: 272-281 [PMID: 1074882]
- 16 **Richardson ME**. The etiology and prediction of mandibular third molar impaction. *Angle Orthod* 1977; **47**: 165-172 [PMID: 268949]
- 17 **Ades AG**, Joondeph DR, Little RM, Chapko MK. A long-term study of the relationship of third molars to changes in the mandibular dental arch. *Am J Orthod Dentofacial Orthop* 1990; **97**: 323-335 [PMID: 2321598]
- 18 **Capelli J**. Mandibular growth and third molar impaction in extraction cases. *Angle Orthod* 1991; **61**: 223-229 [PMID: 1928824]
- 19 **Hattab FN**. Positional changes and eruption of impacted mandibular third molars in young adults. A radiographic 4-year follow-up study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1997; **84**: 604-608 [PMID: 9431526]

- 20 **Erdem D**, Ozdiler E, Memikoğlu UT, Başpınar E. Third molar impaction in extraction cases treated with the Begg technique. *Eur J Orthod* 1998; **20**: 263-270 [PMID: 9699404]
- 21 **Artun J**, Behbehani F, Thalib L. Prediction of maxillary third molar impaction in adolescent orthodontic patients. *Angle Orthod* 2005; **75**: 904-911 [PMID: 16448230]
- 22 **Artun J**, Thalib L, Little RM. Third molar angulation during and after treatment of adolescent orthodontic patients. *Eur J Orthod* 2005; **27**: 590-596 [PMID: 16009666]
- 23 **Behbehani F**, Artun J, Thalib L. Prediction of mandibular third-molar impaction in adolescent orthodontic patients. *Am J Orthod Dentofacial Orthop* 2006; **130**: 47-55 [PMID: 16849071]
- 24 **Breik O**, Grubor D. The incidence of mandibular third molar impactions in different skeletal face types. *Aust Dent J* 2008; **53**: 320-324 [PMID: 19133947 DOI: 10.1111/j.1834-7819.2008.00073.x]
- 25 **Legović M**, Legović I, Brumini G, Vandura I, Cabov T, Ovesnik M, Mestrovic S, Slaj M, Skrinjarić A. Correlation between the pattern of facial growth and the position of the mandibular third molar. *J Oral Maxillofac Surg* 2008; **66**: 1218-1224 [PMID: 18486787 DOI: 10.1016/j.joms.2007.12.013]
- 26 **Hassan AH**. Cephalometric characteristics of Class II division 1 malocclusion in a Saudi population living in the western region. *Saudi Dent J* 2011; **23**: 23-27 [PMID: 23960498 DOI: 10.1016/j.sdentj.2010.10.001]
- 27 **Williams R**, Hosila FJ. The effect of different extraction sites upon incisor retraction. *Am J Orthod* 1976; **69**: 388-410 [PMID: 1062936]
- 28 **Rindler A**. Effects on lower third molars after extraction of second molars. *Angle Orthod* 1977; **47**: 55-58 [PMID: 264778]
- 29 **Haavikko K**, Altonen M, Mattila K. Predicting angulation development and eruption of the lower third molar. *Angle Orthod* 1978; **48**: 39-48 [PMID: 272130]
- 30 **Gaumont G**. Second molar germectomy and third molar eruption. 11 cases of lower second molar enucleation. *Angle Orthod* 1985; **55**: 77-88 [PMID: 3856411]
- 31 **Cavanaugh JJ**. Third molar changes following second molar extractions. *Angle Orthod* 1985; **55**: 70-76 [PMID: 3856410]
- 32 **Richardson ME**. The role of the third molar in the cause of late lower arch crowding: a review. *Am J Orthod Dentofacial Orthop* 1989; **95**: 79-83 [PMID: 2642642]
- 33 **Gooris CG**, Artun J, Joondeph DR. Eruption of mandibular third molars after second-molar extractions: a radiographic study. *Am J Orthod Dentofacial Orthop* 1990; **98**: 161-167 [PMID: 2378320]
- 34 **Stagers JA**, Germane N, Fortson WM. A comparison of the effects of first premolar extractions on third molar angulation. *Angle Orthod* 1992; **62**: 135-138 [PMID: 1626747]
- 35 **Richardson ME**, Richardson A. Lower third molar development subsequent to second molar extraction. *Am J Orthod Dentofacial Orthop* 1993; **104**: 566-574 [PMID: 8249932]
- 36 **Moffitt AH**. Eruption and function of maxillary third molars after extraction of second molars. *Angle Orthod* 1998; **68**: 147-152 [PMID: 9564424]
- 37 **Orton-Gibbs S**, Orton S, Orton H. Eruption of third permanent molars after the extraction of second permanent molars. Part 2: Functional occlusion and periodontal status. *Am J Orthod Dentofacial Orthop* 2001; **119**: 239-244 [PMID: 11244417]
- 38 **Kim TW**, Artun J, Behbehani F, Artese F. Prevalence of third molar impaction in orthodontic patients treated nonextraction and with extraction of 4 premolars. *Am J Orthod Dentofacial Orthop* 2003; **123**: 138-145 [PMID: 12594419]
- 39 **Janson G**, Putrick LM, Henriques JF, de Freitas MR, Henriques RP. Maxillary third molar position in Class II malocclusions: the effect of treatment with and without maxillary premolar extractions. *Eur J Orthod* 2006; **28**: 573-579 [PMID: 16957059]
- 40 **De-la-Rosa-Gay C**, Valmaseda-Castellón E, Gay-Escoda C. Spontaneous third-molar eruption after second-molar extraction in orthodontic patients. *Am J Orthod Dentofacial Orthop* 2006; **129**: 337-344 [PMID: 16527628]
- 41 **Salehi P**, Danaie SM. Lower third molar eruption following orthodontic treatment. *East Mediterr Health J* 2008; **14**: 1452-1458 [PMID: 19161121]
- 42 **Jain S**, Valiathan A. Influence of first premolar extraction on mandibular third molar angulation. *Angle Orthod* 2009; **79**: 1143-1148 [PMID: 19852607 DOI: 10.2319/100708-525R.1]
- 43 **Bayram M**, Ozer M, Arici S. Effects of first molar extraction on third molar angulation and eruption space. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009; **107**: e14-e20 [PMID: 19138633 DOI: 10.1016/j.tripleo.2008.10.011]
- 44 **Livas C**, Halazonetis DJ, Booij JW, Katsaros C. Extraction of maxillary first molars improves second and third molar inclinations in Class II Division 1 malocclusion. *Am J Orthod Dentofacial Orthop* 2011; **140**: 377-382 [PMID: 21889082 DOI: 10.1016/j.jado.2010.06.026]
- 45 **Gohilot A**, Pradhan T, Keluskar KM. Effects of first premolar extraction on maxillary and mandibular third molar angulation after orthodontic therapy. *J Oral Biol Craniofacial Res* 2012; **2**: 97-104 [DOI: 10.1016/j.jobcr.2012.05.004]
- 46 **Türköz C**, Ulusoy C. Effect of premolar extraction on mandibular third molar impaction in young adults. *Angle Orthod* 2013; **83**: 572-577 [PMID: 23311603 DOI: 10.2319/101712-814.1]
- 47 **Mihai AM**, Lulache IR, Grigore R, Sanabil AS, Boiangiu S, Ionescu E. Positional changes of the third molar in orthodontically treated patients. *J Med Life* 2013; **6**: 171-175 [PMID: 23904878]
- 48 **Al Kuwari HM**, Talakey AA, Al-Sahli RM, Albadr AH. Influence of orthodontic treatment with first premolar extraction on the angulation of the mandibular third molar. *Saudi Med J* 2013; **34**: 639-643 [PMID: 23756930]
- 49 **Halicioğlu K**, Toptas O, Akkas I, Celikoglu M. Permanent first molar extraction in adolescents and young adults and its effect on the development of third molar. *Clin Oral Investig* 2014; **18**: 1489-1494 [PMID: 24146200 DOI: 10.1007/s00784-013-1121-1]
- 50 **Dewey M**. Third molars in relation to malocclusion. *Int J Orthod* 1917; **3**: 529-533 [DOI: 10.1016/S1072-3471(17)90221-4]
- 51 **Bergström K**, Jensen R. Responsibility of the third molar for secondary crowding. *Dent Abstr* 1961; **6**: 544
- 52 **Vego L**. A longitudinal study of mandibular arch perimeter. *Angle Orthod* 1962; **32**: 187-192 [DOI: 10.1043/0003-3219(1962)032<0187: ALSOMA>2.0.CO; 2]
- 53 **Sheneman J**. Third molar teeth and their effect upon the lower anterior teeth: a survey of forty-nine orthodontic cases five years after band removal. USA: St. Louis University, 1968
- 54 **Woodside D**. Round table: extra oral force. *J Clin Orthod* 1970; **4**: 554-557
- 55 **Lindqvist B**, Thilander B. Extraction of third molars in cases of anticipated crowding in the lower jaw. *Am J Orthod* 1982; **81**: 130-139 [PMID: 6960702]
- 56 **Forsberg CM**. Tooth size, spacing, and crowding in relation to eruption or impaction of third molars. *Am J Orthod Dentofacial Orthop* 1988; **94**: 57-62 [PMID: 3164583]
- 57 **Southard TE**, Southard KA, Weeda LW. Mesial force from unerupted third molars. *Am J Orthod Dentofacial Orthop* 1991; **99**: 220-225 [PMID: 1998299]
- 58 **Pirtiniemi PM**, Oikarinen KS, Raustia AM. The effect of removal of all third molars on the dental arches in the third decade of life. *Cranio* 1994; **12**: 23-27 [PMID: 8181084]
- 59 **van der Schoot EA**, Kuitert RB, van Ginkel FC, Prah-Andersen B. Clinical relevance of third permanent molars in relation to crowding after orthodontic treatment. *J Dent* 1997; **25**: 167-169 [PMID: 9105149]
- 60 **Basdra EK**, Stellzig A, Komposch G. Extraction of maxillary second molars in the treatment of Class II malocclusion. *Angle Orthod* 1996; **66**: 287-292 [PMID: 8863964]
- 61 **Sidlauskas A**, Trakiniene G. Effect of the lower third molars on the lower dental arch crowding. *Stomatologija* 2006; **8**: 80-84 [PMID: 17191063]
- 62 **Hasegawa Y**, Terada K, Kageyama I, Tsuchimochi T, Ishikawa F, Nakahara S. Influence of third molar space on angulation and dental arch crowding. *Odontology* 2013; **101**: 22-28 [PMID: 22527908 DOI: 10.1007/s10266-012-0065-2]



- 63 **Karasawa LH**, Rossi AC, Groppo FC, Prado FB, Caria PH. Cross-sectional study of correlation between mandibular incisor crowding and third molars in young Brazilians. *Med Oral Patol Oral Cir Bucal* 2013; **18**: e505-e509 [PMID: 23385508]
- 64 **Costa MG**, Pazzini CA, Pantuzo MC, Jorge ML, Marques LS. Is there justification for prophylactic extraction of third molars? A systematic review. *Braz Oral Res* 2013; **27**: 183-188 [PMID: 23538430]
- 65 **Phillips C**, Gelesko S, Proffit WR, White RP. Recovery after third-molar surgery: the effects of age and sex. *Am J Orthod Dentofacial Orthop* 2010; **138**: 700.e1-700.8; discussion 700.e1-700.8; [PMID: 21130316 DOI: 10.1016/j.ajodo.2010.06.013]

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